Using existing undersea fiber cables to detect seismic events

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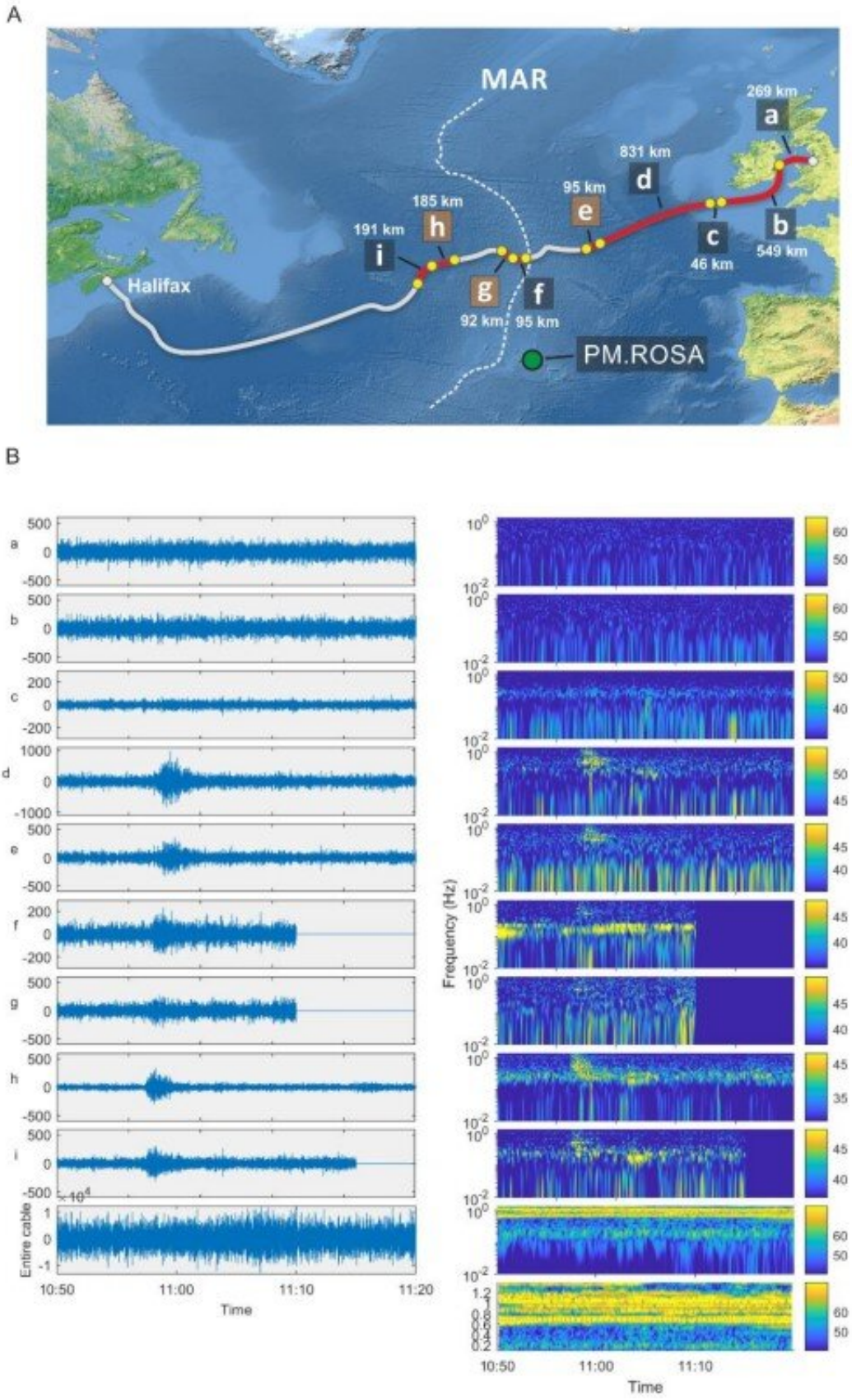
A
MAR
269 km
a
831 km
d
95 km
e
185 km
h
191 km
i
b
549 km
c
46 km
Halifax
g
92 km
f
95 km
PM.ROSA
B
Entire cable
Time
Frequency (Hz)
10:50
11:00
11:10
11:20

Detection of the Northern Peru earthquake. (A) Map of the cable sections used in this measurement. Sections e, g and h correspond to sections S3, S4 and S5 in Fig. 2C. (B) Time series and spectrograms of the signals detected on the 9 spans under test. The panels labeled “Entire cable” shows the time series and spectrogram of the signal detected on the entire UK-Canada. The right bottommost panel shows the spectrogram of the same signal but on a linear scale for better visualization of the higher frequency range (0.2–1.4 Hz). The signal on the entire UK-Canada cable shows a high level of noise preventing the earthquake to be resolved. Credit: *Science* (2022). DOI: 10.1126/science.abo1939

A team of researchers with the National Physical Laboratory and the University of Edinburgh, Google and Istituto Nazionale di Ricerca Metrologica developed a way to use existing undersea fiber cables to detect seismic events. In their paper published in the journal *Science*, the group describes their test project involving a cable spanning the Atlantic Ocean.

Scientists have known that cables can be used to detect seismic activity—work was done as far back as the 1960s to find out if they could be used to detect submarines or undersea earthquakes.

More recently, scientists have looked into the possibility of using distributed acoustic sensing as a way to detect seismic activity. Light pulses are sent across a cable and sensors listen for any that are bounced back due to tremors. Three years ago, a team installed a cable in Monterey Bay in California to test the idea. And another team from Caltech working with Google demonstrated the use of polarization in regular undersea telecommunications cables. In this new effort, the researchers extended the idea of using undersea cables by taking advantage of a feature of the repeaters used on such cables.

Repeaters are used to send signals great distances across the ocean floor—they listen to the signal, amplify it and pass it along. To assist with maintaining operations, repeaters have hardware to send signals in reverse. This helps to isolate problems. The researchers in this new effort used this feature to test using existing cables as underwater seismic sensors. They sent light through a cable that connects the U.K. to Canada and then studied the signals sent back by the repeaters. They found that they were not only able to see seismic activity, they were also able to locate it to points between repeaters. The researchers were able to detect a small earthquake with an origin near Peru and another near Indonesia. They found the cable so sensitive that they were even able to make out noise from moving ocean currents.

The researchers suggest more work is needed to ascertain whether such a system could also provide estimates of the magnitude of undersea quakes. Also, more analysis of signals is required to learn more about the differences between events that pose a danger and those that do not.

More information: G. Marra et al, Optical interferometry–based array of seafloor environmental sensors using a transoceanic submarine cable, *Science* (2022). DOI: 10.1126/science.abo1939